Int J Edu Sci, 16(1-3): 43-51 (2017)
DOI: 10.31901/24566322.2017/16.1-3.06

Declarative Knowledge and Students' Academic Achievement in Map Reading

Sunday B. Adeyemi[1] and Elphina N. Cishe[2]

Walter Sisulu University, Directorate of Research Development, Nelson Mandela Drive, Mthatha South Africa 5117
E-mail: [1]<sadeyemi@wsu.ac.za>, [2]<ecishe@wsu.ac.za>

KEYWORDS Achievement. Dependent Measure. Geography. Map Work. Numerical Ability

ABSTRACT This study seeks to determine which of the learning strategies-cooperative or individualistic, would effectively promote students' acquisition of declarative knowledge in map work. The study employs pretest, posttest, control group, quasi-experimental design. Participants comprised 164 senior secondary II (SSII) geography students (109 boys and 55 girls) drawn by intact class method from three secondary schools. Two hypotheses were tested at 0.05 level of significance. Data was analysed using ANCOVA. Treatment had a significant main effect on students' declarative knowledge DKAT [F (2, 163) = 75.679, p<0. 05]. Cooperative Strategy was most effective for the dependent measure. It was also found that numerical ability had a significant main effect on students' acquisition of declarative knowledge, with high numerical ability subjects performing better than their average and low ability counterparts. The study concludes that declarative knowledge in map work could be better taught through the cooperative learning strategy, considering students' numerical abilities.

INTRODUCTION

The acquisition of knowledge occupies a central position in the teaching-learning process. Hence, the production and dissemination of knowledge remains the hallmark of any institution of learning. Through the acquisition of knowledge, nations are developed as learners are empowered through the knowledge acquired to solve multi-faceted problems in the social, economic, scientific, technological and medical spheres of life, both in their immediate community and the global environment. This viewpoint is consistent with the maxim: "knowledge is power". Owing to its importance, psychologists and other scholars (Schmidmier et al. 2013; Star and Gabriel 2013; Rittle-Johnson and Schneider 2014; Zimmermann 2015; Heilman and Miclea 2015; Sarwar and Trumpower 2015; McCloskey et al. 2016) have done extensive work in identifying types of knowledge and their application in the teaching-learning process. These include the conceptual knowledge- knowing when and why; declarative knowledge- knowledge of facts and concepts; procedural knowledge- knowledge of physical or intellectual process, method or skill; schematic knowledge- knowledge of experience and rote knowledge- memorization amongst others.

In her study titled: "Acquiring knowledge and using it", Smilkstein (1993) identifies three types of knowledge as rote (memorization), declarative (knowledge of concepts) and procedural (knowledge of a physical or intellectual process, method or skill). She observed that knowledge does not automatically transfer between declarative and procedural knowledge, stressing that if teachers want their students to know about and be able do things in different domains, both declarative and procedural knowledge will have to be taught in the same or each different domain. It is gratifying to note that these forms of knowledge are applicable and are found useful in all fields of study including mathematics (Miller and Hudson 2007; Star and Gabriel 2013); neuroscience (Pezzulo 2011); medical field (Schmidmier et al. 2013) as well as the legal system for the training of prospective practitioners. In the study carried out by Wiener et al. (1998) tilted "The Role of Declarative and Procedural Knowledge in Capital Murder Sentencing", the researchers described declarative knowledge as "rule of law", and procedural knowledge as "processes required

Address for correspondence:
Dr. Sunday B Adeyemi
Directorate of Research Development
Walter Sisulu University,
Nelson Mandela Drive, Mthatha,
South Africa 5117
Telephone: +27 79221 1203,
Fax: +27 47502 2185,
E-mail: sadeyemi@wsu.ac.za

to execute the rule of state and federal sentencing law. It is crystal clear from the foregoing that all these forms of knowledge are critical in the learning situation as they cut across all disciplines. It therefore implies that if instructional strategies are to improve learning, they should take cognizance of these forms of knowledge especially declarative and procedural knowledge. While literature is replete on how both declarative and procedural knowledge can improve learning in mathematics and other sciences, not much work has been done on it in the teaching of geography. This is why efforts are made in this present study to beam the search light on Declarative Knowledge and its possible effects on students' learning in map work as an effort to improve students' learning in geography, experimenting with the cooperative and individualistic learning strategies.

Cooperative learning is an active learning strategy that usually involves formally structured groups of three or more students' assigned multi-step exercises, research or development projects or presentations (Brenda and Robert 2003). Many studies have been carried out on active learning techniques and students' attitude towards learning. In a study carried out by Owen et al. (2002) on cooperative active learning strategies using small groups in programming courses for introductory to advanced levels at Duke University, Durham, it was found that the interests and participation of students in class increased in group discussion. They observed that this approach increases students' confidence and self-esteem. They also found out that students who were reluctant to speak out in class became eager to volunteer and discuss a solution that their group developed. Other studies (Majoka et al. 2011; Saleh 2011; Adams 2013; Sani 2015) also reported the effectiveness of cooperative learning strategy in improving students' learning than any of the competitive or individualistic learning strategy.

Individualized instructional learning, on the other hand, is a form of active learning which is based on constructivist theory that individual must construct his own knowledge and skills in relation to his environment. In this strategy all students are taught in one style (usually through a structured set of materials developed by the instructor). The theory behind this instruction is that teachers should vary and adapt their approaches in order to allow the students to construct their own knowledge (Hall 2002). Most importantly this type of learning allows a student to proceed in the process of investigating a given problem. Individualized instruction provides the opportunity for students to learn at their own rate and pace, in their own way and be successful (Omiola et al. 2012). In a study by Christian et al. (2012), it was found out that individualized instructional learning strategy promotes more positive attitudes and academic performance than the conventional lecture method.

Ability generally may be said to refer to the skill, competence, aptitude, talent, capacity, knowledge, proficiency and the capability displayed in doing something well, gained through and experience. This way, ability may be mental or physical (practical), linguistic or numerical amongst others. Numerical ability, which may be categorized into high, medium and low levels, therefore specifically refers to the natural endowment of each student to perform in mathematics. Several studies (Fatoke et al. 2013; Nizoloman 2013; Singh and Kumar 2015; Badru 2016) have been carried out to investigate the effects of numerical ability on students' academic achievement particularly in areas requiring mathematical background, though with differing conclusions. Agoro and Akinsola (2013) observed that students with high numerical ability performed better than their medium and low numerical ability counterparts in chemistry achievement test. Adesoji (2002) was of the opinion that numerical ability of science and social science students is an important factor in effective science teaching and learning process, he concluded that students are not the same especially the rate at which an individual performed a specific task involving mathematical problems. The numerical ability of the participants (the competence students demonstrate in calculation) was considered a critical factor that could have an effect on learners' achievement in map work. This is because most of the activities in map work involve calculation (West African Examination Council {WAEC} 2014), hence its inclusion as a moderator variable.

Statement of the Problem

This study determined the relative effects of cooperative and individualistic learning strategies on students' achievement of declarative knowledge in map work. The study also examined the possible influence of numerical ability on students' acquisition of declarative knowledge in map reading.

Objectives of the Study

The following objectives provided guide for the study:

To determine which of the learning strategies help to improve students' acquisition of declarative knowledge in map reading.

To investigate the effects of numerical ability on students' declarative knowledge in map reading.

Hypotheses

Based on the problem stated above, the study formulated and tested the following null hypotheses at 0.05 level of confidence:

$H_0$1: There will be no statistically significant main effect of learning strategy on students' acquisition of declarative knowledge.

$H_0$2: There will be no statistically significant main effect of numerical ability on students' acquisition of declarative knowledge.

METHODOLOGY

Design

A pretest-posttest, control group, quasi-experimental design was adopted in this study to determine the effects of learning strategies – cooperative and individualistic – on secondary school students' achievement in declarative knowledge in map work. The moderating influence of numerical ability was investigated.

Population

The study population consisted of all the geography students in Senior Secondary II (SS II) in both Ilesa East and West Local Government Council Areas of Osun State, Nigeria.

Sample and Sampling Technique

The sample for the study comprised 164 Senior Secondary II (SSII) geography students (109 boys and 55 girls), drawn from three secondary schools in Ilesa East and West Local Government Areas of Osun State. The participants were drawn through the intact class method. This method of selection was found suitable for the study in order to have adequate size for the sample due to low enrolment in geography classes. Three schools (one from each zone) were randomly selected by simple balloting procedure for the study. The selection of one school from each zone was done in order to control the "contamination effects". All the participating students in each of the schools involved in the study were randomly assigned to cooperative and individualistic experimental groups, and the control group respectively. The study lasted nine weeks.

Research Instruments

The instruments used to collect pertinent data for the study include Numerical Ability Test (NAT), Declarative Knowledge Achievement Test (DKAT), and Treatment Implementation Guides on cooperative, individualistic and the conventional learning strategies**.**

Numerical Ability Test (NAT)

The numerical ability test is a 25-item test adapted from the Australian Council for Educational Research (ACER). There is every need for this test as it forms the basis on which subjects were classified into ability groups, since the subjects' mathematical background is one of the critical factors involved in this study.

Validation of NAT

The numerical ability test was adapted from the Australian Council for educational Research (ACER). The reliability coefficient of the test 0.83 was obtained using Kuder-Richardson formula 21(KR_{21}).

Declarative Knowledge Achievement Test (DKAT)

This test comprised 50 multiple-choice items, which cut across all the topics covered in the study. It is drawn-up to assess the factual knowledge students have acquired of the concepts, principles, laws and topics covered by this study. Specifically, the 50 items were generated under the first two levels of knowledge and comprehension of the cognitive domain. The distribution of these questions is shown in Table 1.

Note that the figure in each cell in Table 1 indicates the number of questions on a topic under the level of cognition in which they appear.

Table 1: Table of specification for DKAT

S. No.	Topics	Levels of cognition		
		Know-ledge	Compre-hension	Total
1	Scales and distances	05	03	08
2	Conventional symbols	05	-	05
3	Relief represen-tation	03	-	03
4	Contour represen-tation of land forms	15	5	20
5	Cross-section drawing	01	03	04
6	Slope measure-ment and gradi-ent calculation	07	03	10
7	Interpretation of topographical maps	-	-	-
	Total	36	14	50

Source: Adeyemi and Cishe 2015

It could be observed from Table 1 that most (72%) of the questions were asked under the first level of cognition, while twentyh-eight percent of the 50 questions came up under comprehension. This is a reflection of the nature of the concepts involved at this stage of study- declarative (factual) knowledge of concepts and principles. It was administered as both pretest and posttest for the study.

Validity and Reliability of DKAT

The difficulty index of the test items ranged between 0.40 and 0.55, while the discrimination index ranged between 0.45 and 0.65. Ten question items of the sixty that were originally drawn up were dropped because they were found inadequate in terms of either the difficulty level or discrimination power. Therefore, fifty items that satisfied these criteria were retained. The reliability coefficient of the test items was calculated using Kuder Richardson formula 21(KR_{21}) to establish the internal consistency of the test items which gave a reliability coefficient of 0.81, which is an acceptable value.

The administration of DKAT on the subjects in all the groups as pretest was carried out before the treatment proper. This was followed by series of lessons designed for different groups involved in the study, using the treatment implementation guides prepared for the different groups. Subjects were presented with class exercises at the end of each period, while DKAT was again administered on the subjects as posttest at the completion of the entire treatment sessions in different groups.

Method of Data Analysis

The data collected from this study was analysed with the use of inferential statistics of Analysis of Covariance (ANCOVA) in which the pretest scores served as covariates. The Multiple Classification Analysis (MCA) was also used to find out how each of the groups performed, while Scheffe's post hoc test was applied to show the direction of the significant differences (if any) among the groups. Hypotheses for this study were tested at 0.05 alpha.

RESULTS

ANCOVA Table 2 shows the main effect of treatment on the dependent measure. As could be observed from this Table, the result is highly significant in achievement test

DKAT [$F(2,163) = 75.679$; $P < 0.05$], based on this, the hypothesis is rejected.

The Multiple Classification Analysis (MCA) Table 3 on post DKAT gives an indication of the

Table 2: Summary of ANCOVA on the posttest DKAT scores according to treatment, and numerical ability level

Source of variation	SS	DF	MS	F	P
Covariates	662.110	1	662.110	5.628	.019
Pretest	662.110	1	662.110	5.628	.019
Main Effects	21312.578	5	4262.516	36.229	.000
Treatment	17807.835	2	8903.918	75.679	.000
Numerical Ability	5601.948	2	2800.974	23.807	.000
Explained	26200.725	18	1455.596	12.372	.000
Residual	17059.781	145	117.654		
Total	43260.506	163	265.402		

Source: Adeyemi and Cishe 2015

performance of each of the experimental groups and the control group. In the Declarative Knowledge Achievement Test (DKAT) for instance, students in the cooperative group performed significantly better than the other two groups – individualistic and control groups in the test.

In Table 3, the cooperative group had the highest adjusted mean score (63.66), followed by the control group (50.43) and the individualistic group had the least mean score of 37.27.

The computed Beta score showed further that treatment contributed the greatest proportion to the variation in the scores. Thus, treatment contributed 43.6 percent ($.66^2$) of the variance in the Declarative Knowledge Achievement Test (DKAT), while the MCA Table revealed multiple R square value of 0.508 for DKAT,

To further search for the source of the significant differences observed among the treatment groups as indicated in the ANCOVA, a Scheffe post-hoc analysis was carried out on the mean scores of the groups in DKAT as found in Table 4.

Thus, it is revealed in these tables that the cooperative group performed consistently better than the other two groups in the achievement test of DKAT. Hence, the cooperative group is superior to both individualistic and the control groups while the control group had the second best posttest mean scores in the achievement test, the individualistic group had the least posttest mean score in the test.

On the strength of the result presented so far, with reference to hypothesis one (H_O1), it is revealed that the subjects differed significantly in their posttest achievement mean scores according to the learning strategies to which the groups were exposed in Declarative Knowledge Achievement Test – DKAT. The cooperative group was found to have obtained the highest achievement mean score of 63.16 in DKAT, while the control group had the second highest posttest mean score of 50.43 in DKAT. The individualistic group had the least mean score of 37.27 in DKAT. However, an important aspect of the findings is that the differences observed among the mean scores of the different groups were statistically significant.

On the basis of these findings, the null hypothesis one (Ho1) that states "there will be no statistically significant main effect of treatment on students' acquisition of declarative knowledge in map reading and interpretation" is rejected.

The results further showed that the cooperative learning strategy is better suited to enhance students' performance in map reading and interpretation at the secondary school level. The control group is observed to have performed

Table 4: Summary of Scheffe post-hoc analysis on posttest means in DKAT according to treatment groups

Groups	*Means*	*Group 2*	*Group 3*	*Group 1*
Group 2	38.6250			
Group 3	50.2456	*		
Group 1	62.3922	*	*	

Source: Adeyemi anad Cishe 2015
Legend:
Group 1 = Cooperative Learning Strategy
Group 2 = Individualistic Learning Strategy
Group 3 = Control
*Denotes pairs of groups significantly different

Table 3: Multiple classification analyses of the posttest DKAT scores according to treatment and numerical ability level

Grand Mean = 50.05					
Variable category	*N*	*Unadjusted Deviations*	*Eta*	*Adjusted for Independents + Covariates*	*Beta*
Treatment					
Cooperative	51	12.34		13.61	
Individualistic	56	-11.43	.59	-12.78	.66
Control	57	.19		.38	
Numerical Ability					
Low	62	-5.89		-7.06	
Average	51	1.73	.30	1.43	.37
High	51	5.44		7.15	
Multiple R^2					.508
Multiple R					.713

Source: Adeyemi and Cishe 2015

better than the individualistic group in the dependent measure.

The results also revealed that there is significant main effect of numerical ability [F (2,163) = 23.807; P< 0.05) in Declarative Achievement Test (DKAT). The Multiple Classification Analysis Table 3 on posttest DKAT scores indicate the performance of the subjects in each of the ability groups of High Numerical Ability Group, Average Numerical Ability Group and Low Numerical Ability Group. The high numerical ability had the highest posttest adjusted mean score of 57.2, the participants in the average ability group had the second highest posttest adjusted mean score of 51.48, and the low ability group had the least posttest adjusted mean score of 42.99.

The Beta values showed that numerical ability contributed the second largest proportion to the variation in the scores of the dependent measure. Thus, numerical ability is found to have contributed 13.7 percent ($.37^2$) of the variance in posttest DKAT scores. The adjusted posttest means scores shown above indicate that participants in the high ability group were consistently scoring higher than participants in the other two groups. Participants in the average ability group followed this. The participants in the low ability group had the least posttest adjusted mean score in the achievement test.

In order to probe further the source of significant differences among the ability groups, a Scheffe Post-hoc analysis was computed on the mean scores of the group in DKAT. These results are presented in Table 5.

Table 5: Summary of Scheffe's post-hoc analysis on posttest means in DKAT according to ability level

Groups	*Means*	*Group 1*	*Group 2*	*Group 3*
Group 1	44.1613			
Group 2	51.7843	*		
Group 3	55.4902	*		

Source: Adeyemi and Cishe 2015
Legend:
Group 1 = Low Ability
Group 2 = Average Ability
Group 3 = High Ability
* Denotes pairs of groups significantly different

DISCUSSION

The results of the Analysis of Covariance (ANCOVA) in Table 2 confirmed that learning strategy had a significant main effect of treatment on DKAT. The Multiple Classification Analysis clearly showed that the cooperative group had a higher mean score over the other two groups. This indicates the apparent superiority of the cooperative learning strategy in teaching map work in secondary schools.

These findings give further empirical support to other findings on the usefulness of cooperative learning strategy above other learning strategies (Alebiosu 1998; Esan 1999; Majoka et al. 2011; Saleh 2011; Adams 2013; Sani 2015). Similarly, Johnson and Johnson (1978) in a meta-analysis involving 122 studies concluded that cooperation is considerably more effective than competitive or individualistic efforts. But on the contrary, Okebukola and Ogunniyi (1984) find out that competition was more superior to cooperative and individualistic class structures in laboratory work. Alebiosu (1998) finds a significant main effect of treatment involving two cooperative learning models on the achievement of subjects in chemistry, while Esan (1999) in his study found that mathematical problem solving skills are best enhanced by cooperative learning environment.

What seems evident from these results is that the cooperative learning strategy has a great potential for effective learning of map work in classrooms at the secondary school level. This may be due to what scholars (Johnson and Johnson 1994; Veenman et al. 2000; Slavin 2000) describe as task and reward structures that characterise the cooperative method of teaching. In the task structure, individual member of the cooperative group is expected to master all aspects of the assignment or task given and be able to explain them. Members help themselves to achieve mastery where and when necessary. In other words, every member is supposed to be actively involved in the study so as to get rid of the "free rider" effect (Slavin 2000; Veenman et al. 2000). The fact that the failure of a member of the cooperative group may have an adverse effect on individuals or groups reward encourages every member of the group to be fully involved in the study. This makes the individual members to be responsible for his learning and that of his mates, giving rise to individual accountability (Johnson and Johnson 1994). The opportunity provided by the cooperative learning strategy whereby peer tutoring takes place, makes it attractive in the teaching and learning of map work in the secondary schools.

The results further showed that subjects in the control group performed better than subjects in the individualistic group. This is so because subjects in the control group could seek or give assistance to one another, in the form of giving further explanations on difficult areas. The teacher may even clarify some 'knotty' areas before the students are left on their own to provide solutions to the class assignments given by the teacher. This result is however contrary to the findings of (Christian et al. 2012; Olaoye et al. 2011) where it was observed that the individualistic learning strategy promotes higher academic performance than conventional lecture method.

Participants in the individualistic group had the least posttest mean score. This is probably so because the individualistic learning structure offers less opportunity for peer interaction (Ojo 1992), whereas cooperative learning environment requires constructive interaction among students (Johnson and Johnson 1986). Students in the individualistic learning group and the control class ignore the achievement striving of other students in the class. This type of learning environment is not likely to stimulate students towards higher achievement (Esan 1999).

The numerical ability of the subjects, that is, the mathematical background or competence students demonstrate in calculation was considered a critical factor that could have an effect on learners' achievement in map work. Map work, which entails map reading, map analysis and map interpretation, involves a lot of calculations as are found in such topics as longitude and time, scale, measurement, bearing, gradient measurement, profile drawing, intervisibility and latitude (Mansaray and Ajiboye1994; WAEC 2014).

Hypothesis two was specifically formulated to determine the probable influence of numerical ability on subjects' achievement in map work. The results of the Analysis of Covariance (ANCOVA) on this hypothesis in Table 2 showed that numerical ability had a high significant main effect on the variations observed in subjects' posttest mean scores in the achievement test. It could be observed that the high numerical ability group performed consistently better in both the cooperative and individualistic groups. The results further indicated that even in the control group that was exposed to the conventional method, high numerical ability subjects performed better.

However, the major finding here is that, interestingly, all the different ability groups in the cooperative group performed better than their corresponding counterparts in the individualistic and the control groups. These findings lend support to other previous findings of (Okebukola 1984; Ojo 1988; Esan 1999; Fatoke et al. 2013; Nizoloman 2013). The result is however contrary to the findings of Singh and Kumar (2015), where students performed poorly in mathematics due to poor numerical background on the one hand, and Badru (2016) findings on the other hand, where it was found that numerical ability had no significant main effect on students' achievement in mathematics. These results have a more serious implication for the learning of map work in secondary schools. The results are a pointer to the fact that students need sound mathematical background as earlier claimed by Mansaray and Ajiboye (1994) in order to be able to do well in map work in schools.

CONCLUSION

The conclusions that could be attempted from these results are:

Treatment has main effect on the dependent measure. The Cooperative learning strategy is superior to the other two strategies in students' acquisition of declarative knowledge in map work. Even all the numerical ability groups in cooperative group performed better than their counterparts in the other groups.

Numerical ability has significant main effect on students' achievement in DKAT. High numerical ability subjects performed consistently better than the average and low ability subjects in the dependent measure of DKAT, though there was a variation in the mean scores of the average and low ability subjects, it was not found to be statistically significant.

It is therefore implied in these results that numerical ability wields a great deal of influence on students' acquisition of declarative knowledge in map reading and interpretation.

That geography teacher should endeavour to identify what constitutes declarative knowledge in map work and devote time to teach them in order to enhance students' performance in map work.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

Geography teachers should endeavor to identify what constitutes declarative knowledge in map work and teach them. This is because declarative knowledge represents the initial knowledge base in geographic education to which the students should be exposed, operating at the lower levels of the cognitive domain as it answers the question: What? This will be in compliance with the pedagogical principle of teaching from known to unknown and simple to complex.

The teaching/learning process should be restructured so as to accommodate new instructional strategies that will enhance students' performance. The cooperative learning strategy, which has proved effective, is hereby recommended for use. Hence the old and stereotyped lecture method of teaching map work should be discouraged.

Geography teachers who are already in schools should be given on the job training through organized workshops, seminars and symposia where they would be exposed to all that is involved in the cooperative learning strategy.

Geography teachers should be made to recognize the fact that declarative knowledge is central to better performance in map work. Hence, teachers should make concerted efforts to specifically devote time to this area during lessons. The curricula of all Teacher Training institutions in the country should be broadened to encompass the different learning strategies that promote effective learning.

Cooperative learning strategy that facilitated students' acquisition of declarative knowledge in map work actually needs time to succeed. Hence, more time should be allocated to it on the school time-table, as the present three periods per week is grossly inadequate. It is hereby suggested that between six and eight periods be allotted to geography a week for mastery learning.

REFERENCES

Adams AR 2013. *Cooperative Learning Effects on the Classroom*. MEd Dissertation, Unpublished. USA: Northern Michigan University.

Adesoji FA 2002. Modern strategies in the teaching of integrated science. *Journal of Research in Education*, 1(1): 71-75.

Adeyemi SB, Cishe EN 2015. Data collection from the field.

Agoro AA, Akinsola MK 2013. Differential effectiveness of reflective- reciprocal teaching and reflective reciprocal peer tutoring on pre-service teachers' achievement and science process skills in integrated science. *International Journal of Education and Research*, 1(8): 1-20.

Alebiosu KA 1998. *Effects of Two Cooperative Learning Models on Senior Secondary Students' Learning Outcomes in Chemistry*. PhD Thesis, Unpublished. Ibadan: University of Ibadan.

Ande II 2003. Developing requisite skills for effective learning of map work in 6-3-3-4 system of Education. *The Nigerian Geography Teachers Association Journal (South-western Zone)*, 4(2): 129-143.

Badru AK 2016. Problem- based instructional strategy and numerical ability as determinants of senior secondary achievement in mathematics. *Journal of Education and Practice*, 7(13): 89-95.

Christian M, Pepple TF 2012. Cooperative and individualized learning strategies as predictors of students' achievement in secondary school chemistry in Rivers State. *Journal of Vocational Education & Technology*, 9(2): 109-124.

Esan AO 1999. *Effects of Cooperative and Individualistic Problem-solving Strategies on Students' Learning Outcomes in Secondary School Mathematics*. PhD Thesis, Unpublished. Ibadan: University of Ibadan.

Fatoke AO, Ogunlade TO, Ibidiran VO 2013. The effects of problem-solving instructional strategy and numerical ability on students' learning outcomes. *The International Journal of Engineering and Science (IJES)*, 2(10): 97-102.

Hall T 2002. Differentiated Instruction. Wakefield, MA: National Center on Accessing the General Curriculum. From <http://www.cast.org/publications/ncac/ncac_diffinstruc.html> (Retrieved on 24 January 2006).

Heilman RM, Miclea M 2015. The contributions of declarative knowledge and emotion regulation in Iowa gambling task. *Academic Journal Article*, *Cognitie, Creier, Comportament*, 19(1): 35-47.

Johnson DW, Johnson RT 1978. Cooperative, competitive and individualistic learning. *Journal of Research and Development in Education*, 12(1): 3-15.

Majoka MI, Khan MS, Shah S 2011. Effectiveness of cooperative learning for teaching social studies to different ability at elementary levels. *Interdisciplinary Journal of Contemporary Research in Business*, 2(11): 486-495.

Mansaray A, Ajiboye JO 1994. Topic difficulty in senior secondary school geography. *Abraka Journal of Curriculum Studies*, 11(1): 80-92.

McCloskey M, Ovans Z, Landau B 2016. Declarative memory and skill-related knowledge: Evidence from a case study of amnesia and implications for theories of memory. *Cognitive Neuropsychology*, 33(3-4): 220-240.

Miller SP, Hudson PJ 2007. Using evidence-based practices to build mathematics competence related to conceptual, procedural and declarative knowledge. *Journal of Learning Disabilities, Research and Practice*, 22(1): 47-57. Doi:10.1111/j.1540-5826. 00230. x.

Nizoloman ON 2013. Relationship between mathematical ability and achievement in mathematics among female secondary school students. *Procedia - Social and Behavioral Sciences*, 106: 2230-2240.

Ojo MO 1988. *The Differential Effectiveness of Cooperative, Competitive and Individualistic Goal Structures on Students' Performance in Chemistry*. PhD Thesis, Unpublished. Ibadan: University of Ibadan.

Ojo MO 1992. The differential effectiveness of cooperative, competitive and individualistic classroom interaction patterns on students' chemical problem solving skills. *The Nigeria Teacher Today*, 1(2): 121-129.

Okebukoia PAO 1984. *Effects of Cooperative and Individualistic Laboratory Interaction Patterns on Students' Performance in Biology*. PhD Thesis, Unpublished. Ibadan: University of Ibadan.

Okebukoia PA, Ogunniyi MB 1984. Cooperative, competitive and individualistic science laboratory interaction patterns: Effects on students' achievement and acquisition of practical skills. *Journal of Research in Science Teaching*, 21(19): 875-884.

Omiola MA, Enuwa MR, Awoyemi SO, Adebayo RF 2012. Effects of blended learning and individualized instructional strategies on the cognitive learning outcomes in basic technology. *British Journal of Science*, 6(1): 38-44.

Owen L, Astrachan Robert C, Duvall Jetto-Forbes, Susan H Rodge 2002. Active Learning in Small to Large Courses. *32nd ASEE/TEEG Frontiers in Education Conference*, 6-9 November, Boston, M.A.

Pezzulo G 2011. Grounding procedural and declarative knowledge in sensorimotor anticipation. *Journal of Mind and Language*, 26(1): 78-114. Doi: 10.1111/j. 1468 0017.2010.01411.

Rittle-Johnson B, Schneider B 2014. Developing conceptual and procedural knowledge of mathematics. In: RC Kadosh, A Dowker (Eds.): *The Oxford Handbook of Numerical Cognition*. Oxford University Press.DOI:10.1093/oxfordhb/9780199642342. 013.014.

Saleh TA 2011. Statistical Analysis of Cooperative and Individualistic Learning Strategies. From <http://www.uncw.edu/jet/articles/Vol11_1/Saleh.pdf> (Retrieved on 25 October 2016).

Sani UT 2015. Effects of Cooperative Learning Strategy. From <http://jesoc.com/wp-content/uploads/2015/07/1.Edu9_KLiCELS1_ Edu_9_ 3rMUmrc QnA.pdf> (Retrieved on 27 October 2016).

Sarwar GS, Trumpower DL 2015. Effects of conceptual, procedural, and declarative reflection on students' structural knowledge in physics. *Education Tech Research Development*, 63(2): 185-201.doi:10. 1007/s11423-015-9368-7.

Schmidmier R, Stephan Eiber S, Ebersbach R, Schiller M et al. 2013. Learning facts in medical school is not enough. *BMC Medical Education*,13: 28. DOI: 10.1186/1472-6920-13-28.

Singh P, Kumar N 2015. Achievement in mathematics of secondary school students in relation to their numerical aptitude. *International Journal of Management and Social Sciences Research (IJMSSR)*, 4(5): 100-103.

Slavin RE 2000. *Cooperative Learning and Achievement: Theory, Research and Future Directions*. Office of Educational Research and Improvement. US: Department of Education.

Smilksten R 1993. *Acquiring Knowledge and Using It*. Washington: Seattle Community College District.

Star JR, Gabriel JS 2013. Procedural and conceptual knowledge: Exploring the gap between knowledge type and knowledge quality. *Canadian Journal of Science, Mathematics, and Technology Education*, 13(2): 169-181.

Timmerman Brenda, Lingard Robert 2003. Assessment of Active Learning with Upper Division Computer Science Students. *33rd ASEE/TEE, Frontiers in Education Conference*, 5- 8 November, Bounder, Co.

Veenman S, Renter B, Post K 2000.Cooperative learning in Dutch primary classrooms. *Educational Studies*, 26(3): 281-302.

WAEC 2014. *West African Examinations Council: Chief Examiners Reports*. Lagos: Author.

Wiener RL, Hurt LE, Thomas SL 1998. The role of declarative and procedural knowledge in capital murder sentencing. *Journal of Applied Social Psychology*, 28(2): 124-144.

Zimmermann KA 2015. Declarative Memory: Definition and Example. From <http://www. livescience. com/43153-declarative-memory.html> (Retrieved on 7 November 2016).

Paper received for publication on February 2016
Paper accepted for publication on December 2016